4/10

28

1 CODEWORD
(11 CHIPS)

26

01000101111101101000

DATA

22

OUT

PN

20

BASEBAND
DATA BIT

27

24

01001000111
11 CHIPS

FIG. 1

FIG. 2

DATA
IN

SCRAMBLER — 54

52 → 51

MODULATOR — 58

56

RF FRONT
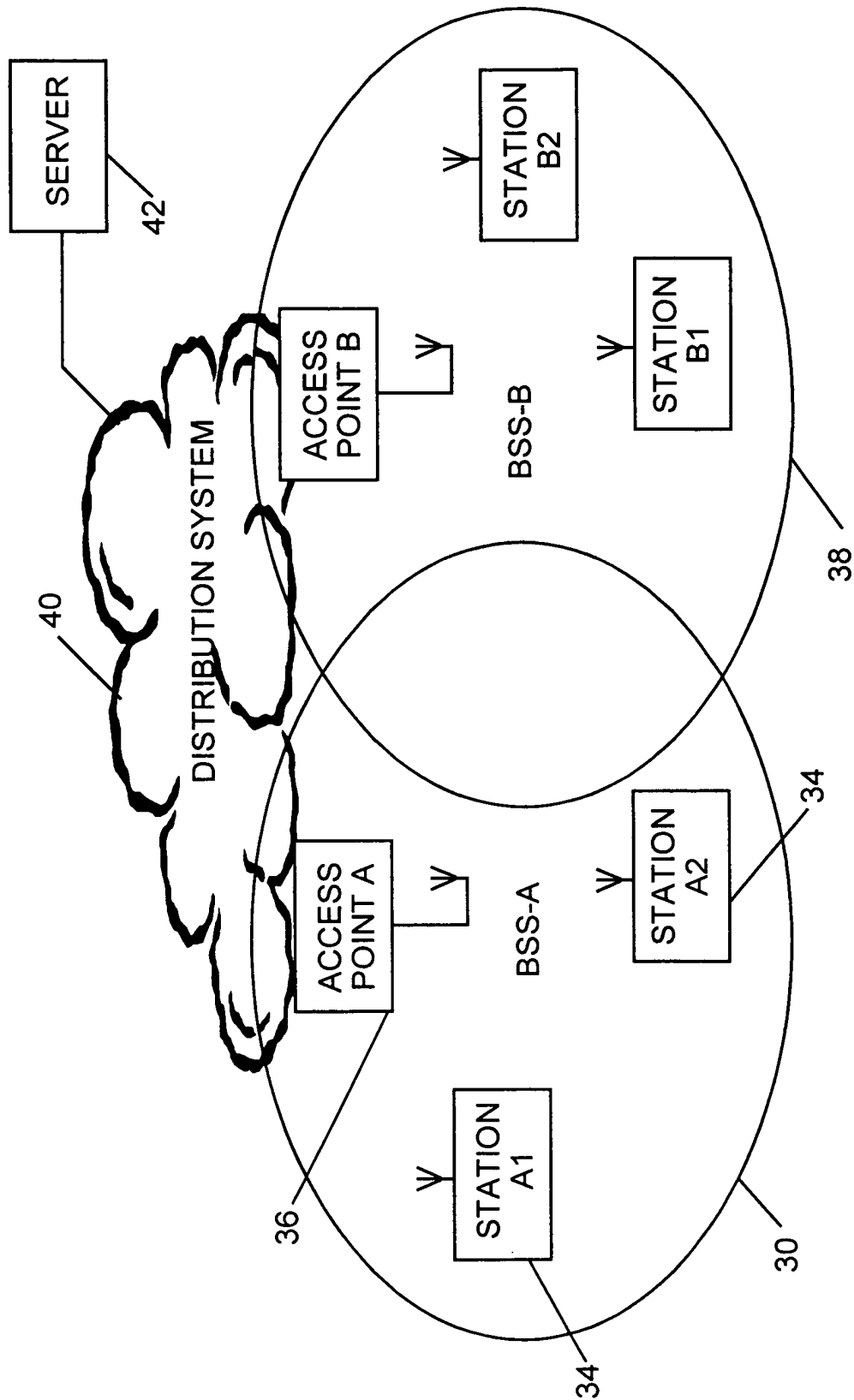END — 62

64

50

60

DATA
OUT

DESCRAMBLER — 72

74 →

DEMODULATOR — 71

70

RF FRONT
END — 68

67

66

FIG. 3

FIG. 4

(PRIOR ART)

FIG. 5

DATA →
132

MUX
1:16

134

$(d_{12}, d_{13}, d_{14}, d_{15})$ — 136

$(d_8, d_9, d_{10}, d_{11})$ — 138

(d_4, d_5, d_6, d_7) — 140

(d_0, d_1, d_2, d_3) — 142

SELECT
1 OF 256
SUBCODES

144

DIFFERENTIAL
PHASE ENCODE

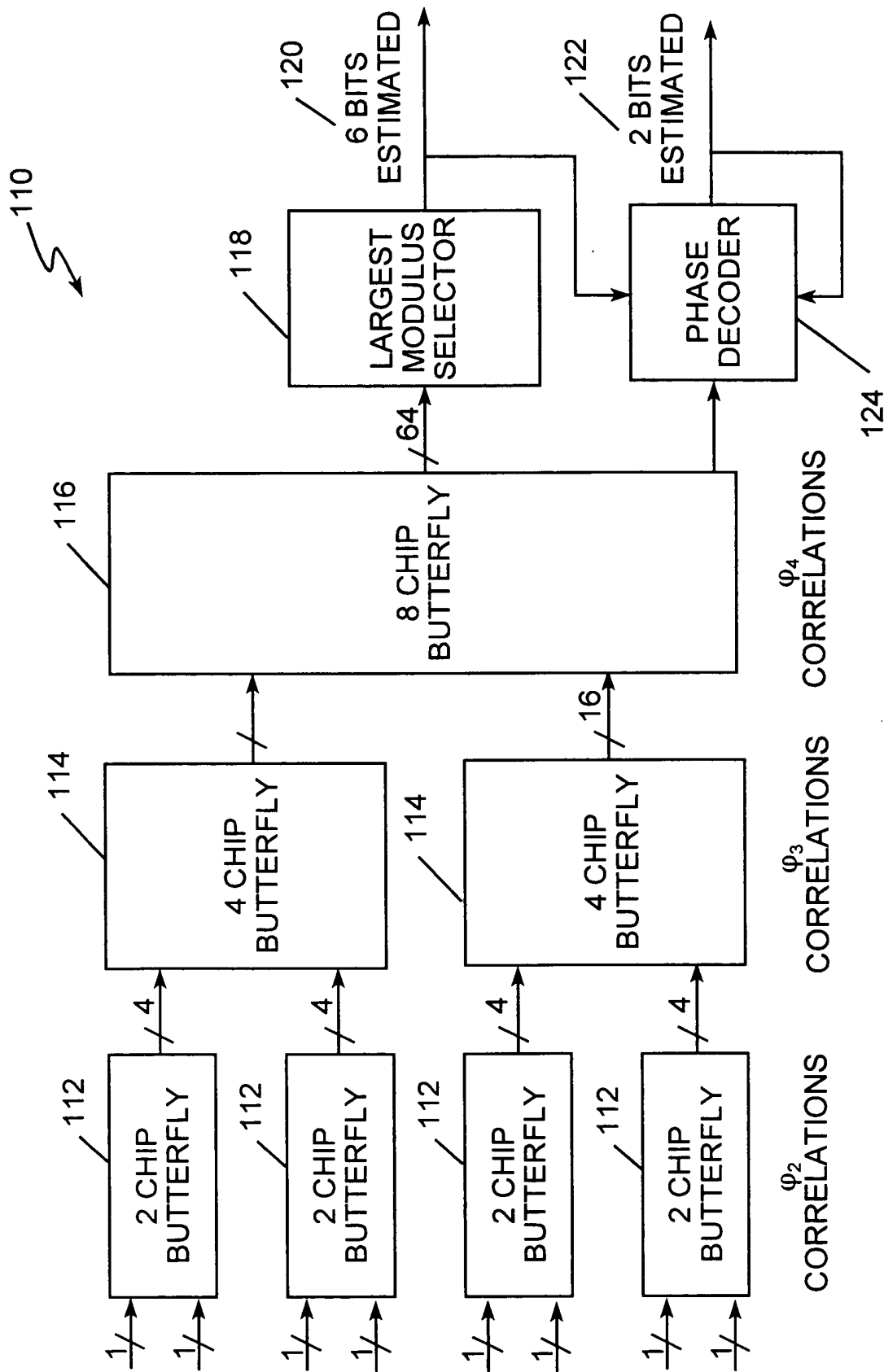148

INDEXER

150

ϕ_1

152

PHASE
ROTATE

100

130

1 OF 4096
CODEWORDS

154
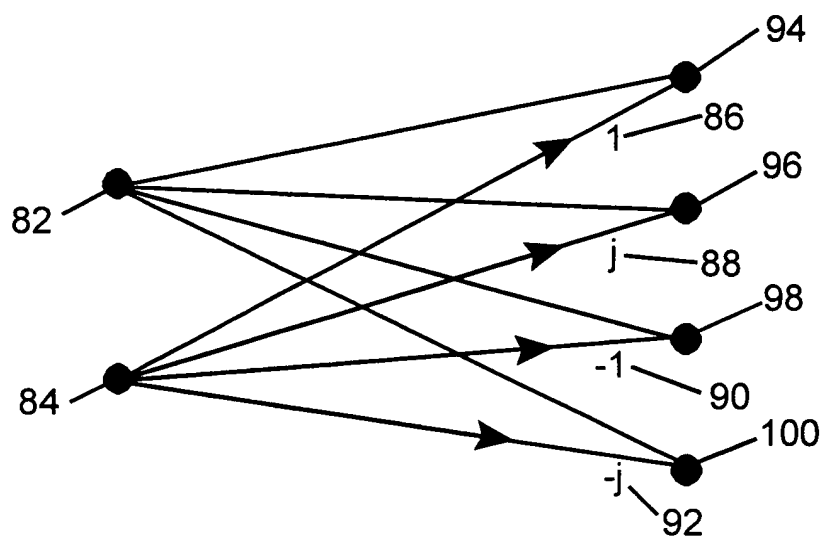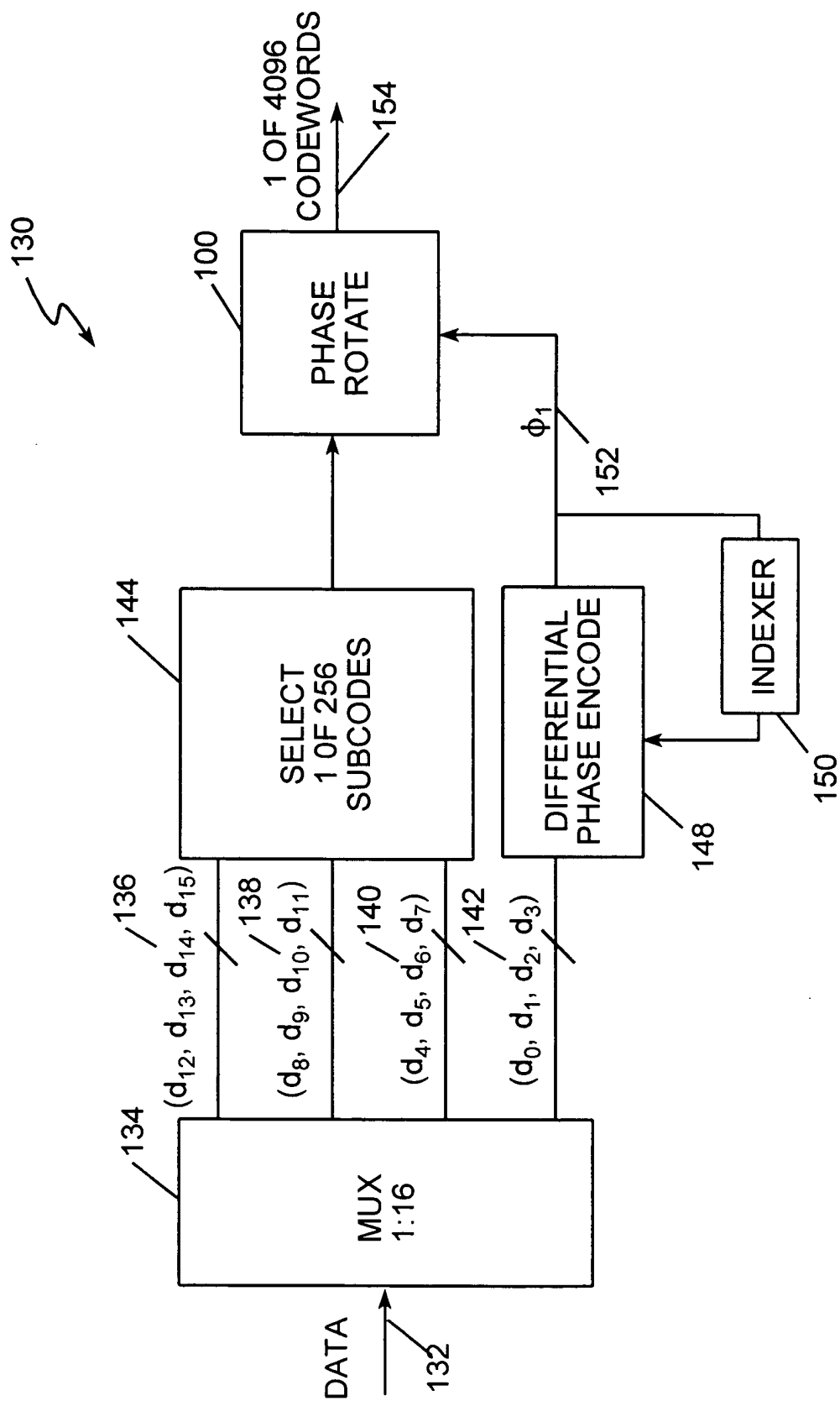
FIG. 6

$$M_2 = \begin{bmatrix} \exp(j\varphi_2) & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \exp(j\varphi_2) & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \exp(j\varphi_2) & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -\exp(j\varphi_2) & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

164

$$M_3 = \begin{bmatrix} \exp(j\varphi_3) & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \exp(j\varphi_3) & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \exp(j\varphi_3) & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \exp(j\varphi_3) & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

162

$$M_4 = \begin{bmatrix} \exp(j\varphi_4) & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \exp(j\varphi_4) & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \exp(j\varphi_4) & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \exp(j\varphi_4) & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

160

FIG. 7

$$M_{2E} = \begin{vmatrix} \exp(j\varphi_2+\psi_2) & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \exp(j\varphi_2+\psi_2) & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \exp(j\varphi_2+\psi_2) & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -\exp(j\varphi_2+\psi_2) & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{vmatrix}$$

170

$$M_{3E} = \begin{vmatrix} \exp(j\varphi_3+\psi_3) & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \exp(j\varphi_3+\psi_3) & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \exp(j\varphi_3+\psi_3) & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \exp(j\varphi_3+\psi_3) & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{vmatrix}$$

172

$$M_{4E} = \begin{vmatrix} \exp(j\varphi_4+\psi_4) & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \exp(j\varphi_4+\psi_4) & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \exp(j\varphi_4+\psi_4) & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \exp(j\varphi_4+\psi_4) & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{vmatrix}$$
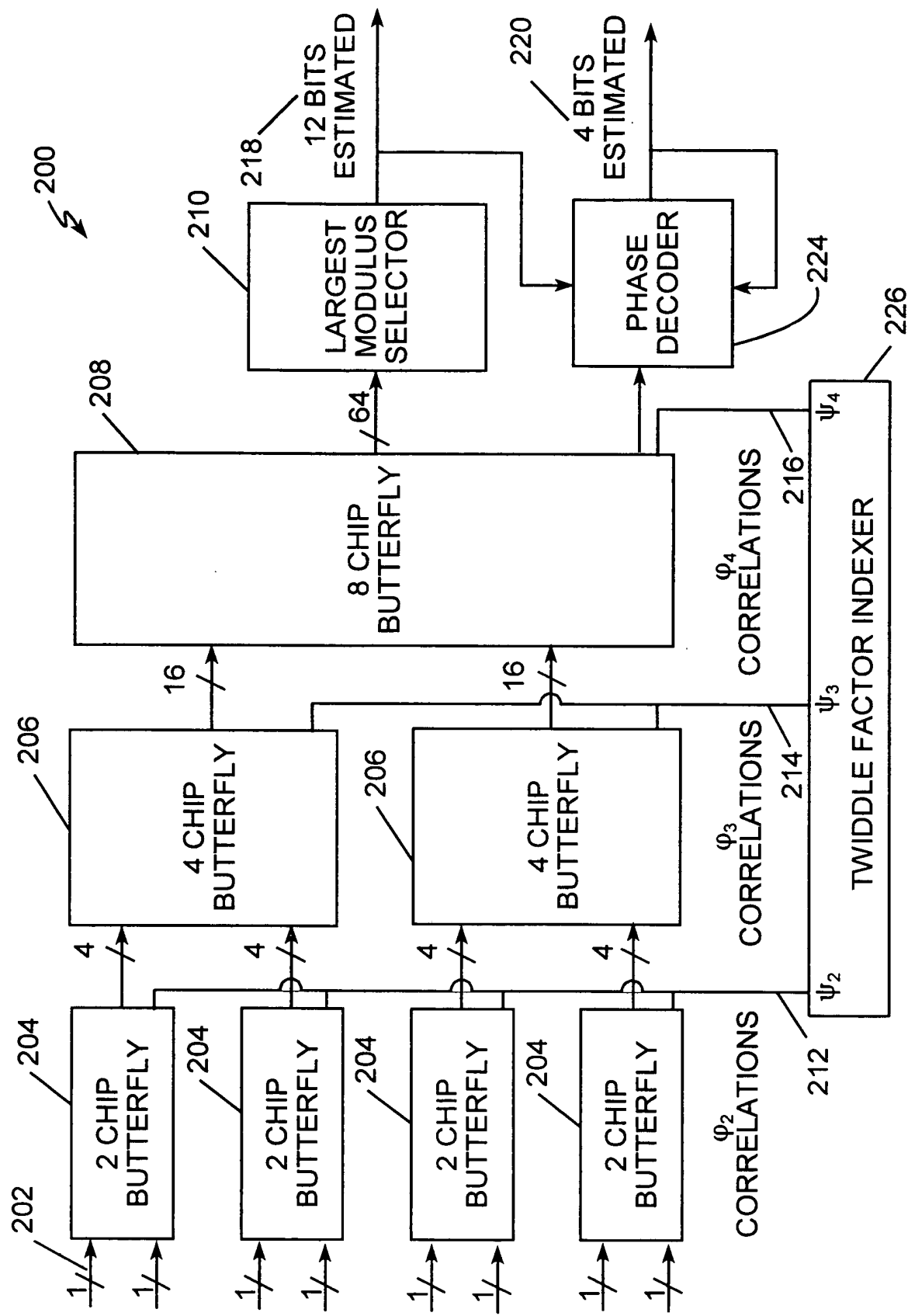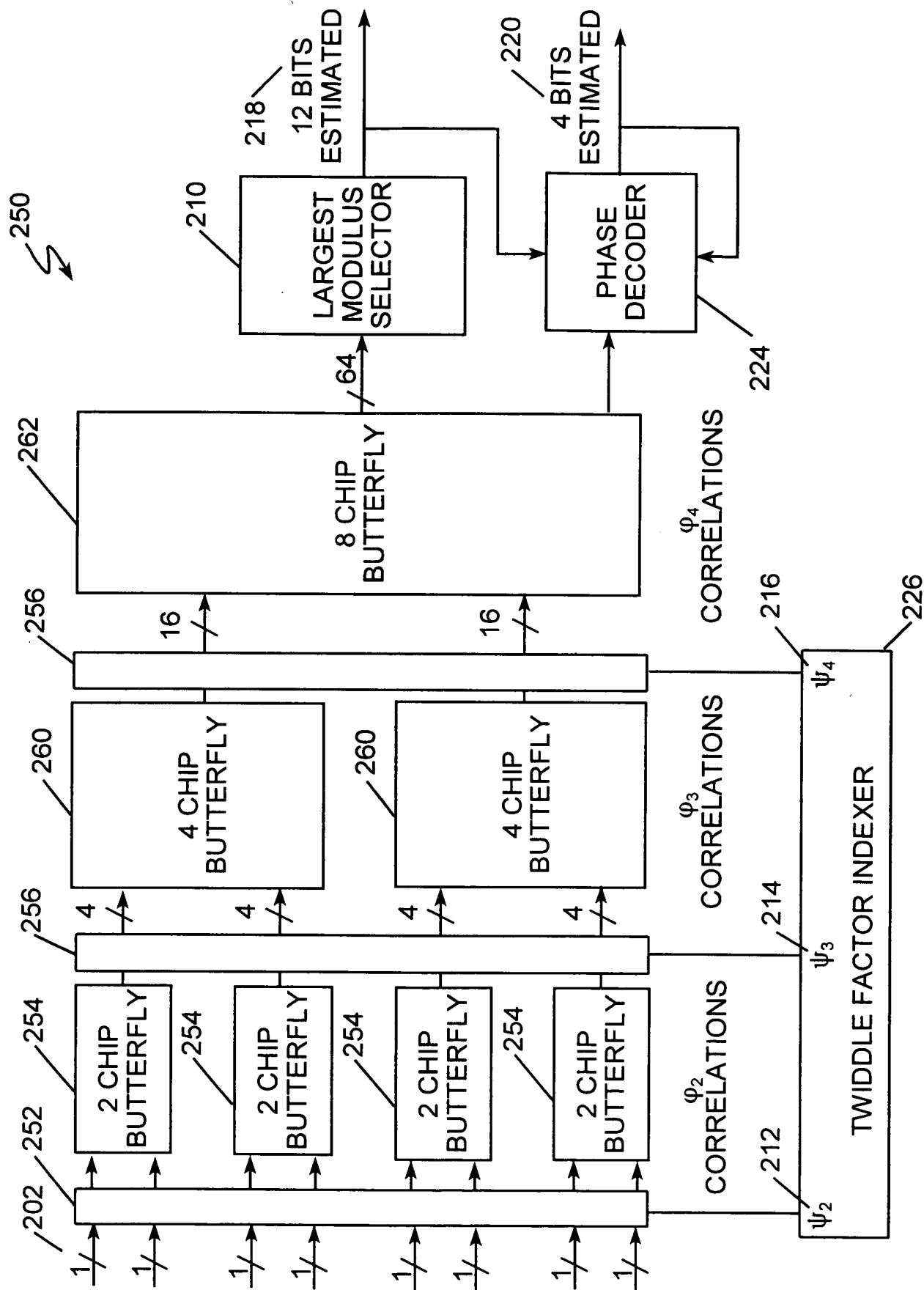
174

FIG. 8

200

12 BITS
ESTIMATED

218

LARGEST
MODULUS
SELECTOR

210

220

4 BITS
ESTIMATED

PHASE
DECODER

224

208

64

8 CHIP
BUTTERFLY

226

ψ_4

φ_4
CORRELATIONS

216

206

16

4 CHIP
BUTTERFLY

16

206

4 CHIP
BUTTERFLY

ψ_3

214

φ_3
CORRELATIONS

204

4

204

4

204

4

204

4

2 CHIP
BUTTERFLY

2 CHIP
BUTTERFLY

2 CHIP
BUTTERFLY

2 CHIP
BUTTERFLY

202

TWIDDLE FACTOR INDEXER

ψ_2

212

φ_2
CORRELATIONS

FIG. 9

FIG. 10